UNITED STATES DEPARTMENT OF COMMERCE
National Telecommunications and Information Administration
Washington, D.C. 20230

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June 24, 1999

Ms. Magalie Roman Salas
Secretary
Federal Communications Commission
The Portals
445 Twelfth Street, S.W.
Washington, D.C. 20554

Re: The Establishment of Policies and Service Rules for the Mobile Satellite in the 2 GHz, IB Docket No. 99-81, RM-9328

Dear Ms. Salas:

Enclosed please find one original and six copies of the Comments of the National Telecommunications and Information Administration in the above-referenced docket and rulemaking. The comments were also submitted in electronic form on diskettes in WordPerfect 5.1 to Christopher J. Murphy with the International Bureau and delivered to the Commission's copy contractor, International Transcription Service.

Please direct any questions you may have regarding this filing to the undersigned. Thank you for your cooperation.

Respectfully submitted,

Kathy Smith
Acting Chief Counsel

cc: Christopher J. Murphy, International Bureau
International Transcription Service

Enclosures

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Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554

In the Matter of	)	
	)	
The Establishment of Policies	)	IB Docket No. 99-81
and Service Rules for the Mobile	)	RM-9328
Satellite Service in the 2 GHz Band	)	

COMMENTS OF THE NATIONAL TELECOMMUNICATIONS AND INFORMATION ADMINISTRATION

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June 24, 1999

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EXECUTIVE SUMMARY

The National Telecommunications and Information Administration (NTIA) applauds the Commission for its efforts in providing additional spectrum allocations for the development of mobile satellite services. It is expected that the 2 GHz allocation will provide spectrum to meet the projected demands of new entrants and existing mobile satellite service (MSS) providers. NTIA would like to also commend the Commission on it efforts in implementing the international Global Mobile Personal Communications by Satellite Memorandum of Understanding (GMPCS MOU) which will support the deployment of GMPCS service in the United States and around the world. As discussed in these comments, NTIA remains concerned about a number of issues vital to the future needs and operations of the Federal aeronautical radionavigation community and implementation of the Global Navigation Satellite System (GNSS) and its constituent elements the United States Global Positioning System (GPS) and the Russian Federation Global Navigation Satellite System (GLONASS).

The GPS Standard Positioning Service (SPS) Signal Specification has been amended in recognition that many civil GPS receivers utilize the entire transmitted bandwidth of the Coarse/Acquisition code signal to minimize tracking errors due to noise, interference, and multipath. NTIA requests that the Commission modify Section 25.213(b) of its Rules to reflect the amended SPS Signal Specification.

NTIA recommends that the methodology established in Recommendation ITU-R S.1342 be used for determining the coordination distance between aeronautical radionavigation service (ARNS) Microwave Landing System (MLS) stations and 2 GHz MSS feeder link earth stations operating in the 5091-5250 MHz band. NTIA also requests that the 2 GHz MSS feeder link

earth stations in the 5091-5250 MHz band be subject to the standard process in which the Commission coordinates such applications through the Frequency Assignment Subcommittee (FAS) of the Interdepartment Radio Advisory Committee (IRAC) to ensure that harmful interference between MSS feeder links and Government operations is minimized.

Based on Recommendation ITU-R S.1340 and studies completed within the International Telecommunication Union - Radiocommunications Sector (ITU-R), NTIA recommends that the Commission limit the band requested for feeder uplinks to the 15.43-15.63 GHz portion of the 15.4-15.7 GHz ARNS band. Limiting the feeder links to this portion of the band will minimize impact to existing ARNS systems, radio astronomy observations, and MSS feeder link operations. To facilitate the implementation of feeder link earth stations, NTIA recommends that the methodology established in Annex 3 of Recommendation ITU-R S.1340 be used for determining the coordination distance between ARNS stations and 2 GHz MSS feeder link earth stations operating in the 15.43-15.63 GHz band. NTIA further requests that the 2 GHz MSS feeder link earth stations in the 15.43-15.63 GHz band be subject to the standard process in which the Commission coordinates such applications through the Frequency Assignment Subcommittee (FAS) of the Interdepartment Radio Advisory Committee (IRAC) to ensure that harmful interference between MSS feeder links and Government operations is minimized.

NTIA agrees with the Commission's proposal to require the 2 GHz MSS operators to perform their Tracking, Telemetry, and Command (TT&C) functions within the assigned feeder link frequency bands. NTIA recommends that to the extent practicable, 2 GHz MSS operators should locate their TT&C signal at the upper end of the 5091-5150 MHz band.

NTIA recommends that the Commission adopt a wide band equivalent isotropically radiated power (EIRP) limit of -70 dBW/MHz and a narrow band limit of -80 dBW on unwanted emission in the 1559-1626.5 MHz band for MSS mobile earth terminals operating in the 1990-2025 MHz band. NTIA believes that these unwanted emission limits will protect GNSS Category I operations and facilitate GMPCS certification thru the harmonization of adopted international standards.

NTIA proposes that the out-of-band emissions for 2 GHz MSS systems employing Time Division Multiple Access (TDMA) techniques be averaged over a time interval of duration that is equal to the length of the transmission time slot. The basis for this proposal is that the Wide Area Augmentation System (WAAS) transmits more data than GPS and thus has a symbol duration that is 10 times shorter than a GPS data symbol, making it more susceptible to long duration pulsed signals. For 2 GHz MSS systems employing Code Division Multiple Access (CDMA) techniques, the 20 millisecond measurement interval proposed by the Commission is appropriate.

NTIA recommends that the carrier-off limit for a 2 GHz MSS mobile earth terminal be 10 dB below the carrier-on limit to account for a cumulative power effect. The cumulative effect is attributed to the significant majority of MSS terminals in the carrier-off state.

NTIA believes that a user in need of emergency assistance should receive help independent of which type of wireless device that person is using. This should be independent of whether the network is terrestrially based or satellite-based. Since the ability to locate users in distress is in the public's best interest, NTIA supports the implementation of position location capabilities for the 2 GHz MSS terminals authorized for use in the United States.

NTIA supports the Commission's proposal that any 2 GHz MSS system authorized to operate inter-satellite service links in the bands shared on a co-equal basis with Government operations would be required to coordinate with the Government systems. NTIA recommends that the Commission require that non-geostationary 2 GHz MSS licensees operate their inter-satellite links in the 65-71 GHz band, which is proposed to be reallocated for non-Government inter-satellite service.

NTIA supports the Commission's tentative conclusion that distress and safety rules should be adopted for 2 GHz MSS systems. NTIA recommends that the Commission modify Section 25.143(f) of the Commission's Rules, 47 C.F.R. § 25.143(f), to include the 1990-2025/2165-2200 MHz bands.

Priority must be given to Aeronautical Mobile Satellite (Route) Service (AMS(R)S) traffic within MSS systems in specific bands. At this time the only action needed is to strengthen the existing ITU Radio Regulation footnotes addressing AMS(R)S priority and preemption by including a requirement for AMS(R)S provision, and to complete the ITU-R Working Document toward a Draft New Recommendation on MSS provision of AMS(R)S.

Detailed discussion of the technical parameters of Boeing's proposed Navigation Augmentation Service will be necessary with the Department of Defense and the Federal Aviation Administration before NTIA could concur. These discussions are necessary to ensure that interference is not caused to GPS.

In order to protect radio astronomy receivers, the aggregate power flux density from all satellites in a constellation employing the 10.7-10.95 GHz and 11.2-11.45 GHz band for feeder downlinks will have to be at least -255 $dBW/m^2/Hz$.

NTIA requests that the 2 GHz MSS feeder link operations in the 17.8-20.2 GHz band be subject to the standard process in which the Commission coordinates such applications through the Frequency Assignment Subcommittee (FAS) of the Interdepartment Radio Advisory Committee (IRAC) to ensure that harmful interference between MSS feeder links and Government operations is minimized.

NTIA is concerned that the out-of-band emissions from the 2 GHz MSS downlinks operating in the upper portion of the 2165-2200 MHz could interfere with adjacent band Government space operations. Moreover, interference to adjacent band Government space systems must be taken into consideration when the Commission adopts power limits and out-of-band emission limits for the 2 GHz MSS downlink band.

NASA recommends that ITU-R Recommendations could be used in the development of policies and rules for the implementation of MSS at 2 GHz. NASA believes that if care is taken in the initial design phases of MSS systems that mutually satisfactory, interference-free operations of both services is feasible.

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COMMENTS OF THE NATIONAL TELECOMMUNICATIONS AND INFORMATION ADMINISTRATION

The National Telecommunications and Information Administration (NTIA), an Executive Branch agency within the Department of Commerce, is the President's principal adviser on domestic and international telecommunications policy, including policies relating to the Nation's economic and technological advancement in telecommunications. Accordingly, NTIA makes recommendations regarding telecommunications policies and presents Executive Branch views on telecommunications matters to the Congress, the Federal Communications Commission, and the public. NTIA, through the Office of Spectrum Management, is also responsible for managing the Federal Government's use of the radio frequency spectrum. NTIA respectively submits the following Comments in response to the Commission's Notice of Proposed Rulemaking in the above-captioned proceeding.[1]

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[1] *The Establishment of Policies and Service Rules for the Mobile Satellite Service in the 2 GHz Band*, IB Docket No. 99-81 and RM No. 9328, FCC 99-50 (rel. March 25, 1999) (hereinafter *2 GHz MSS NPRM*).

I. INTRODUCTION

As a result of the 1992 World Administrative Radio Conference (WARC-92), primary international allocations were adopted for the 1980-2010 MHz (uplink) band and 2170-2200 MHz (downlink) band mobile-satellite service (MSS) worldwide, and the 2165-2170 MHz band to MSS in Region 2[2] to be effective January 1, 2000.[3] In 1994, the Commission allocated portions of the international 2 GHz MSS allocation specifically for domestic terrestrial mobile service use by Personal Communications Services (PCS).[4] Consequently, in 1995, the United States sought additional international spectrum for 2 GHz MSS at the 1995 World Radiocommunications Conference (WRC-95),[5] and WRC-95 adopted additional spectrum for 2 GHz MSS. Effective January 1, 2000, the 2010-2025 MHz (uplink) band and the 2165-2170 MHz (downlink) band will be available for MSS in the United States and Canada. Effective January 1, 2005, the 2010-2025 MHz (uplink) band will be available for MSS in all of Region 2. In 1997, the Commission allocated the 1990-2025 MHz (uplink) and 2165-2200 MHz (downlink) bands to MSS in the United States.[6]

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[2] The world is divided into three Regions by agreement of the Members of the International Telecommunication Union (ITU). The United States is in Region 2, which encompasses the Americas and Greenland.

[3] Final Acts of the 1992 World Administrative Radio Conference, Malaga-Torremolinos (1992).

[4] *Amendment of the Commission's Rules to Establish New Personal Communications Services*, GEN Docket No. 90-314, Memorandum Opinion and Order, 9 F.C.C. Rcd. 4957 (1994) (allocating, *inter alia*, the 1980-1990 MHz band to terrestrial PCS).

[5] *Preparation for International Telecommunication Union World Radio Conferences*, IC Docket No. 94-31, Report, 10 F.C.C. Rcd. 12783, 12798-99, 12845-47 (1995).

[6] *Amendment of Section 2.106 of the Commission's Rules to Allocate Spectrum at 2 GHz for Use by the Mobile-Satellite Service,* ET Docket No. 95-18, First Report and Order and

Following the allocation in 1997, the Commission has received six applications and three letters of intent from non-U.S. companies to provide 2 GHz MSS services in the United States. The 2 GHz MSS applicants are the Boeing Company, Celsat, Constellation Communications, Inc., Globalstar, L.P., Iridium LLC, and Mobile Communication Holding, Inc. The companies seeking reservation of spectrum to serve the U.S. market from non-U.S. licensed systems are ICO, Inmarsat Horizons, and TMI Communications and Company, Limited Partnership. The nine 2 GHz MSS system proponents propose a mixture of system designs (geostationary orbit and non-geostationary orbit systems) as well as different modulation technologies (time division multiple access (TDMA), code division multiple access (CDMA), and, in some cases, both TDMA and CDMA).

In this NPRM, the Commission is proposing to use the MSS above 1 GHz (Big LEO) policies and rules[7] as a starting point for the development of policies and rules for the 2 GHz MSS. The Commission believes that this is a logical approach since the issues are similar because the mobile satellite services proposed are essentially the same as those provided by the Big LEOs *(i.e.*, voice, data and fax via MSS), and because the proposed 2 GHz MSS system designs are similar to those used by the Big LEOs (*i.e.*, CDMA and TDMA system architectures). In addition, since several of the 2 GHz MSS system proponents are proposing geostationary systems or geostationary components, the Commission is also proposing to apply their

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Further Notice of Proposed Rulemaking, 12 F.C.C. Rcd. 7388, 7393-95 (1997)(*2 GHz MSS Allocation Order*).

[7] *Amendment of the Commission's Rules to Establish Rules and Policies Pertaining to a Mobile Satellite Service in the 1610-1626.5/2483.5-2500 MHz Frequency Bands*, CC Docket No. 92-166, Report and Order, 9 F.C.C. Rcd. 5936 (1994), *on recon.*, Memorandum Opinion and Order, 11 F.C.C. Rcd. 12861 (1996).

geostationary policies and service rules where applicable.

In addition to the service links, the 2 GHz MSS NPRM also addresses the feeder link frequency bands requested by the 2 GHz MSS participants. Two of the frequency bands requested for 2 GHz MSS feeder links are allocated to the aeronautical radionavigation service (ARNS) and used for safety-of-life operations.

NTIA applauds the Commission for its efforts in providing additional spectrum allocations for the further development of mobile satellite services. The proposal for 2 GHz MSS systems, like the other systems, promise to provide new and expanded regional and global voice, data, and message services. It is expected that the 2 GHz allocations will provide spectrum to meet the projected demands of new entrants and existing MSS providers. NTIA would also like to commend the Commission on it efforts in implementing the international Global Mobile Personal Communications by Satellite Memorandum of Understanding (GMPCS MoU) which will support the deployment of GMPCS service in the United States and around world. These GMPCS systems will provide additional choices for delivery of seamless voice, data, and broadband services for consumers in all parts of the world. NTIA, however, offers the following comments to specific issues raised in the 2 GHz MSS NPRM that NTIA believes will likely have a direct and significant impact upon the future needs and operations of the Federal aeronautical radionavigation community.

II. THE COMMISSION SHOULD MODIFY ITS RULES TO REFLECT THE AMENDMENT TO THE SPS SIGNAL SPECIFICATION.

The bandwidth for the Global Positioning System (GPS) is given as 1565.42-

1585.42MHz.[8] In the third edition of the GPS Standard Positioning Service (SPS) Signal Specification, to be released later this year, the bandwidth for the GPS Coarse Acquisition (C/A) code signal centered at 1575.42 MHz (L_1) has been amended as follows:

> The L-band SPS ranging signal is a 2.046 MHz null-to-null bandwidth signal centered on L1. The transmitted ranging signal that comprises the GPS-SPS is not limited to the null-to-null signal and extends through the band 1563.42 to 1587.42 MHz.[9]

The SPS Signal Specification was amended in recognition that civil GPS receivers utilize the entire transmitted bandwidth of the C/A code signal to minimize tracking errors due to noise, interference, and multipath. The power dispersed over the bandwidth of a GPS signal is extremely important for high accuracy civilian safety-of-life applications for two reasons. First, the achievable tracking accuracy (in terms of ranging variance) of a signal is inversely proportional to the root-mean-square (RMS) signal bandwidth. The implication is that the further the signal power is dispersed from the carrier frequency, the more important it is in reducing nominal tracking errors. Second, the most effective multipath mitigation techniques for GPS rely on having a very sharp cross-correlation (between the incoming C/A code signal and the receiver replica) function. Sharpness of the cross-correlation function is provided by having a very wide bandwidth to capture the signal power well beyond the first lobe of the signal.

Since it is anticipated that many of the civilian applications that demand a higher degree of accuracy, including safety-of-life applications, will use the full transmitted bandwidth of the

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[8] *See 2 GHz MSS NPRM* at ¶ 68.

[9] Letter from James R. Beale, Brig Gen, USAF Acting Deputy Assistant Secretary of Defense (C3ISR and Space Systems) to Mr. Joseph F. Canny, Deputy Assistant Secretary for Transportation Policy (Sept. 11, 1998).

GPS C/A code signal, NTIA requests that the Commission conform Section 25.213(b) of its Rules to the amended SPS Signal Specification.

III. ITU-R RECOMMENDATIONS SHOULD BE USED FOR ESTABLISHING COORDINATION DISTANCES BETWEEN ARNS STATIONS AND MSS FEEDER LINK STATIONS IN THE 5091-5250 MHz BAND.

Several of the 2 GHz MSS participants have identified portions of the 5091-5250 MHz band for their feeder uplink spectrum.[10] The International Civil Aviation Organization (ICAO) Standard Microwave Landing System (MLS) operates on 200 channels in the 5030-5091 MHz portion of the band. MLS is an all weather precision approach and landing system that supports navigation and guidance for suitably-equipped aircraft out to a range of 43 kilometers and an altitude of 6096 meters. Within the International Telecommunication Union-Radiocommunications Sector (ITU-R), Recommendation ITU-R S.1342 has been developed and establishes a method for determining coordination distances relative to current and planned MLS stations that may be used to enable implementation of MSS feeder link earth stations.[11] The MLS frequency allocation is 5031-5150 MHz, where 5031-5091 MHz is currently used for existing MLS channel assignments, and 5091-5150 MHz is designated by ICAO for future MLS expansion channels. To facilitate the implementation of feeder link earth stations, NTIA recommends that the methodology established in Recommendation ITU-R S.1342 be used for determining the coordination distance between MLS stations and 2 GHz MSS feeder link earth stations operating

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[10] *See 2 GHz MSS NPRM* at ¶50.

[11] Recommendation ITU-R S.1342, Method for Determining Coordination Distances in the 5 GHz Band, Between the International Standard Microwave Landing System Stations Operating in the Aeronautical Radionavigation Service and Non-Geostationary Mobile Satellite Service Stations Providing Feeder Uplink Services.

in the 5091-5250 MHz band. NTIA further recommends that the Commission adopt a domestic footnote similar to international footnote S.444A, with a reference to Recommendation ITU-R S.1342.

Discussions will be necessary between NTIA and the Commission to determine the service rules that will be applicable to the 2 GHz MSS feeder link earth stations operating in the fixed-satellite service (Earth-to-space) (*e.g.*, minimum earth station elevation angle, power limits, earth station antenna criteria). NTIA also requests that the 2 GHz MSS feeder link earth stations in the 5091-5250 MHz band be subject to the standard process in which the Commission coordinates such applications through the Frequency Assignment Subcommittee (FAS) of the Interdepartment Radio Advisory Committee (IRAC) to ensure that harmful interference between MSS feeder links and Government operations is minimized.

IV. 2 GHz MSS FEEDER UPLINKS SHOULD BE LIMITED TO THE 15.43-15.63 GHz PORTION OF THE 15.4-15.7 GHz ARNS BAND.

Several of the 2 GHz MSS participants have identified the 15.4-15.7 GHz band for their feeder uplink spectrum. The band 15.4-15.7 GHz is extensively used by the ARNS for airborne, land and ocean based stations. Specifically, the aircraft landing system (ALS), aircraft multipurpose radars (MPR), and radar sensor and measurement system (RSMS) operate throughout the 15.4-15.7 GHz band. In addition, surface based radar (SBR) operates in the 15.6375-16.7125 GHz band. Recommendation ITU-R S.1340 recommends that feeder links for the MSS should be limited to the 15.43-15.63 GHz portion of the 15.4-15.7 GHz band.[12] Studies

[12] Recommendation ITU-R S.1340, Sharing Between Feeder links for the Mobile-Satellite Service and the Aeronautical Radionavigation Service in the Earth-to-Space Direction in the Band 15.4-15.7 GHz.

completed within the ITU-R have determined that limiting the feeder links to the 15.43-15.63 GHz frequency range will minimize the impact to ARNS systems, adjacent band radioastronomy observations, and MSS feeder link operations. Based on the discussion above, NTIA requests that the Commission limit the band for 2 GHz MSS feeder links to the 15.43-15.63 GHz frequency range.

To facilitate the implementation of feeder link earth stations, NTIA recommends that the methodology established in Annex 3 of Recommendation ITU-R S.1340 be used for determining the coordination distance between ARNS stations and 2 GHz MSS feeder link earth stations operating in the 15.43-15.63 GHz band. Discussions will be necessary between NTIA and the Commission to determine the service rules that will be applicable to the 2 GHz MSS feeder link earth stations operating in the fixed-satellite service (Earth-to-space) (*e.g.*, minimum earth station elevation angle, power limits, earth station antenna criteria). NTIA also requests that the 2 GHz MSS feeder link earth stations in the 15.43-15.63 GHz band be subject to the standard process in which the Commission coordinates such applications through the Frequency Assignment Subcommittee (FAS) of the Interdepartment Radio Advisory Committee (IRAC) to ensure that harmful interference between MSS feeder links and Government operations is minimized.

V. 2 GHz MSS TT&C FUNCTIONS SHOULD BE PERFORMED WITHIN THE ASSIGNED FEEDER LINK FREQUENCY BANDS.

NTIA agrees with the Commission's proposal to require the 2 GHz MSS operators to perform their Tracking, Telemetry, and Command (TT&C) functions within the assigned feeder link frequency bands. The current rules require U.S. domestic satellites to conduct TT&C

functions at either or both edges of the bands used for MSS feeder links.[13] However, the requested 5091-5150 MHz feeder link band is adjacent to current MLS operations in the 5031-5091 MHz. The TT&C signal typically has a higher power spectral density than the communication links since all weather communication between the earth station and the satellites is crucial in emergency situations. Placing the TT&C signal at the lower end of the 5091-5150 MHz band could make coordination with MLS operations more difficult, and may result in additional constraints being placed on feeder link earth station transmissions.[14] Therefore, NTIA recommends that to the extent practicable that 2 GHz MSS operators locate their TT&C signal in the middle or at the upper end of the 5091-5150 MHz band.

VI. UNWANTED EMISSION LIMITS PROPOSED FOR THE 1605-1610 MHz PORTION OF THE RNSS BAND ARE NOT APPROPRIATE FOR 2 GHz MSS EARTH TERMINALS.

The Commission is proposing to adopt out-of-band emission limits for the 2 GHz MSS mobile earth terminals operating in the 1990-2025 MHz band that are the same as the limits proposed for the Big LEO MSS mobile earth terminals operating in the 1610–1626.5 MHz band. The Commission states that the proposed emission limits are intended to protect certain aeronautical radionavigation operations and to facilitate GMPCS certification. Specifically, in the 1559-1605 MHz portion of the 1559-1610 MHz band, the Commission proposes to adopt a wide band equivalent isotropically radiated power (EIRP) limit of -70 dBW/MHz and a narrow band EIRP limit of -80 dBW. In the 1605-1610 MHz portion of the band, the Commission

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[13] 47 C.F.R. § 25.202(g).

[14] Letter from William D. Gamble, Deputy Associate Administrator, Office of Spectrum Management, to William R. Torak, Federal Communications Commission Liaison Representative, IRAC (Nov. 22, 1996).

proposes to adopt limits of -70 dBW/MHz at 1605 MHz and -10 dBW/MHz at 1610 MHz with the levels in between determined by linear interpolation. The Commission seeks comment on whether any additional provisions may be appropriate or needed concerning unwanted emissions.[15]

The unwanted emission levels proposed by the Commission for the 1559-1610 MHz band were developed specifically for Big LEO MSS mobile earth terminals operating in the adjacent 1610-1626.5 MHz band. These out-of-band levels were developed based on interference susceptibility limits that will allow a Global Navigation Satellite System (GNSS) receiver, operating in the 1559-1605 MHz portion of the 1559-1610 MHz radionavigation satellite service (RNSS) band, to meet Category I accuracy and continuity requirements for aeronautical radionavigation.[16] The GNSS consists of the U.S. GPS, the Russian Federation Global Navigation Satellite System (GLONASS), and their augmentation systems.

NTIA supports the unwanted emission limits of -70 dBW/MHz (wide band) and -80 dBW (narrow band) in the 1559-1605 MHz portion of the RNSS band as proposed by the Commission. However, the unwanted emission limits proposed by the Commission in the 1605-1610 MHz portion of the band represents a compromise that was reached between aviation and Big LEO MSS communities. These limits are based on the practical out-of-band emission levels that can be achieved by an MSS terminal operating in the adjacent band.[17] The reason that these emission

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[15] *See 2 GHz MSS NPRM* at ¶ 116.

[16] RTCA Inc., Special Committee No. 159, *Assessment of Radio Frequency Interference Relevant to the GNSS*, Document No. RTCA/DO-235 (RTCA/DO-235) (Jan. 27, 1997).

[17] The proposed EIRP limits of -70 dBW/MHz (wide band) and -80 dBW (narrow band) over the RNSS frequency band are the limits that will protect the GNSS receivers under a

limits are applicable to Big LEO MSS terminals and not applicable to 2 GHz MSS terminals is obvious. It is more difficult for MSS terminals transmitting on assigned frequencies between 1610-1626.5 MHz to suppress emissions in the 1559-1610 MHz than it would be for 2 GHz MSS terminals, where a 380 MHz frequency separation exists. Since the filtering requirements to suppress emissions in the 1559-1610 MHz are less stringent for 2 GHz MSS terminals NTIA does not believe that the unwanted emission limits in the 1605-1610 MHz portion of the band as proposed by the Commission are appropriate.

Furthermore, if it is the Commission's intent to establish emission limits for 2 GHz MSS mobile earth terminals that will facilitate GMPCS certification, it is important that harmonized technical standards be established by all participating administrations. The ITU-R has adopted a recommendation for licensing administrations concerning regulatory limits on out-of-band emissions from MSS terminals licensed for transmission to non-geostationary satellites in the frequency bands between 1 to 3 GHz.[18] For MSS terminals operating in the 1980-2025 MHz band, the ITU-R recommendation specifies an unwanted emission limit of -70 dBW/MHz in the 1559-1626.5 MHz band. This ITU-R recommendation was developed to facilitate circulation of GMPCS user terminals and the full implementation of the GMPCS.

The European Testing and Standards Institute (ETSI) has also developed terminal essential requirements for MSS mobile earth stations in the 2 GHz band. The ETSI standard

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specific scenario. One of the most important elements of the scenario was the assumption that there would be only one interfering MSS transmitter at any give time. As a result of this assumption the entire GNSS interference budget was allocated to this one MSS interference source. If multiple sources were considered the allowable interference would be lower.

[18] Recommendation ITU-R M.1343, Essential Technical Requirements of Mobile Earth Stations for Global Non-Geostationary Mobile-Satellite Service Systems in the Bands 1-3 GHz.

specifies an unwanted emission limit of -70 dBW/MHz in the 1559-1626.5 MHz band. This unwanted emission limit would apply to MSS mobile earth terminals operating in the 1980-2009.9 MHz band.[19]

Based on adopted international standards, NTIA recommends that the Commission adopt a wide band limit of -70 dBW/MHz and a narrow band limit of -80 dBW on unwanted emissions in the 1559-1626.5 MHz band for MSS mobile earth terminals operating in the 1990-2025 MHz band. NTIA believes that these unwanted emission limits will protect GNSS Category I operations and facilitate GMPCS certification and the global roaming of MSS terminals.

VII. THE MEASUREMENT TIME INTERVAL FOR UNWANTED EMISSIONS WILL DEPEND ON THE MODULATION TECHNOLOGY EMPLOYED BY 2 GHz MSS MOBILE EARTH TERMINALS.

The Federal Aviation Administration (FAA) has initiated plans to transition from its present ground-based navigation and landing system to a satellite-based system. However, GPS alone will not meet all aviation positioning requirements. To meet the National Airspace System (NAS) requirements, the FAA has proposed two augmentations to GPS: a Wide Area Augmentation System (WAAS) and a Local Area Augmentation System (LAAS). The WAAS signal will provide the augmentation to GPS to obtain the required accuracy improvement for precision approaches, as well as integrity, continuity, and availability of navigation for all phases of flight. A study performed by the Johns Hopkins University Applied Physics Laboratory (JHU/APL) concluded that GPS must be augmented to satisfy navigation performance

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[19] European Testing and Standards Institute TBR-042, Satellite Personal Communications Networks (S-PCN); Mobile Earth Stations (MESs), Including Handheld Earth Stations, for S-PCN in the 2.0 GHz Band Under the Mobile-Satellite Service (MSS); Terminal Essential Requirements (Feb. 1998).

requirements and that the WAAS and the LAAS can provide the required navigation performance.[20] The JHU/APL study also considered interference to GPS and its augmentation systems and recommended that regulations be developed for all licensed transmitters that explicitly limit radio frequency emissions at satellite radionavigation frequencies.[21]

The out-of-band emission limits proposed by the Commission are the average values to be measured over a 20 millisecond (msec) time interval. The 20 msec time interval is related to the 50 symbols/sec data rate of the GPS/GLONASS navigation message with a corresponding symbol duration of 20 msec (1/50). However, the WAAS transmitted data stream has a data rate of 500 symbols/second with a corresponding symbol duration of 2 msec (1/500).[22] As a result of the shorter symbol duration, WAAS receivers are more vulnerable to disruption by long duration pulsed signals. The longer duration pulses will overlap more of the shorter duration WAAS symbols resulting in an increase in bit error rate (BER) and the corresponding word error rate (WER) in the data demodulation performed in GPS and WAAS (GNSS) receivers. An analysis was performed that examined the BER and WER performance of GPS and WAAS receivers.[23] As shown in this analysis, a WAAS receiver is more susceptible to increases in BER and WER than a GPS receiver.

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[20] Johns Hopkins University Applied Physics Laboratory, *GPS Risk Assessment Study Final Report* (JHU/APL Study), VS-99-007, at ES-1 (Jan. 1999).

[21] *Id.* at ES-6.

[22] In addition to the navigation data the WAAS signal contains integrity data, ionospheric correction data, and GPS clock error correction data.

[23] *See RTCA/DO-235* at Appendix C.

The baseline data rate for WAAS is 250 bits/second. The data will be ½ rate convolutional encoded with a Forward Error Correction (FEC) code. Therefore, the symbol rate that the receiver must process is 500 symbols/second. The convolutional coding for WAAS will be constraint length 7 as standard for Viterbi coding. WAAS employs the convolutional code to partially make up for the degradation in bit energy due to its faster data rate as compared to GPS. Pulses that are longer than 2 msec will cause symbol erasures in the Viterbi decoder.[13] An erasure is a position in the demodulated sequence where the symbol value is unknown, thereby increasing the BER. The effects on the convolutional decoding will depend upon the nature of the pulsed signal (*e.g.*, random, periodic, or other).

The 2 GHz MSS earth terminals proposed for operation in the 1990-2025 MHz band will employ either CDMA or TDMA multiple access techniques.[14] For 2 GHz MSS terminals employing CDMA, the level of unwanted emission are constant over a nominal time period and the 20 msec measurement interval is adequate. However, for 2 GHz MSS terminals employing TDMA the unwanted emission levels will be related to the duration of the transmission time slot.[15] To provide protection to WAAS receivers, NTIA proposes that the unwanted emissions of MSS terminals employing CDMA be averaged over a 20 msec time interval. For 2 GHz MSS terminals employing TDMA the unwanted emissions should be averaged over a time interval of duration that is equal in length to the transmission time slot.

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[13] Clark & Cain, *Error Correction Coding for Digital Communications*, Plenum, New York (1998).

[14] *See 2 GHz MSS NPRM* at ¶ 8.

[15] TDMA systems divide the radio frequency spectrum into time slots, which are the same as pulses, and in each time slot only one user is allowed to either transmit or receive.

VIII. 2 GHz MSS TERMINAL CARRIER-OFF EMISSION LIMITS MUST BE LESS THAN CARRIER-ON LIMITS.

Both ETSI and the ITU-R recognize that MSS terminals operating in the 1990-2025 MHz band have two operational states: carrier-on and carrier-off. In the carrier-on state, an MSS terminal is transmitting a signal in a continuous or non-continuous mode. In the carrier-off state, an MSS terminal is powered-on but not transmitting a signal. The emission limits proposed by the Commission only apply to the situation where an MSS terminal is in the carrier-on state. When an MSS terminal is in the carrier-off (*e.g.*, stand-by) state, any emissions should be held to levels that are lower than those for the carrier-on state. While this is obvious, a provision still needs to be included in the service rules, otherwise the probability of more than one MSS terminal being in a position to cause interference to an aircraft in a final approach landing becomes unacceptably large. Therefore, NTIA recommends that the carrier-off limit be 10 dB lower that the carrier-on limit to account for a cumulative power effect. The cumulative effect is attributed to the significant majority of MSS terminals in the carrier-off state.

IX. POSITION LOCATION CAPABILITIES SHOULD BE REQUIRED FOR 2 GHz MSS TERMINALS AUTHORIZED IN THE UNITED STATES.

The Commission seeks comment on whether 2 GHz MSS earth terminals should be required to implement their system with Enhanced 911 (E 911) capabilities.[16] NTIA notes that the Commission has acted to require wireless carriers to deliver 911 and to meet a schedule for introducing the features of E 911 calls from wireless devices such as cellular and personal

[16] *Id.* at ¶ 98.

communication services (PCS), whose networks are terrestrially based.[17] Effective April 1, 1998, wireless carriers are required to implement Phase I of this schedule, provided certain conditions were met.[18] Under Phase I rules, carriers must provide Automatic Number Identification (ANI) and cell site information for 911 calls to public Safety Answering Points (PSAP).[19] Phase II, which requires the deployment of the capability to determine the location of callers, latitude and longitude, is scheduled for October 1, 2001.[20] NTIA believes that a user in need of emergency assistance should receive help independent of which type of wireless device that person is using. This should be independent of whether the network is terrestrially based or satellite-based. Since the ability to locate users in distress is in the public's best interest, NTIA supports position location capabilities for the 2 GHz MSS earth terminals authorized for use in the United States.

The United States Coast Guard (USCG) has stated that MSS systems should be included in the requirements for wireless providers to provide compatibility with E 911 emergency calling systems. It is envisioned that 2 GHz MSS terminals could be used by persons in distress in remote maritime areas. To provide effective search and rescue support it is essential that the USCG know the location of individuals in distress and be able to confirm the existence of a distress situation. In order to do this, the USCG must be able to immediately determine ANI and Automatic Location Identification (ALI) information. The ALI information is necessary to

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[17] *See generally, Revisions of the Commission's Rules to Ensure Compatibility with Enhanced 911 Emergency Calling Systems*, CC Docket No. 94-102, Memorandum Opinion and Order, 12 F.C.C. Rcd. 22665 (1997).

[18] *See* 47 C.F.R. § 20.18(d).

[19] *Id.*

[20] *See* 47 C.F.R. § 20.18(e).

ensure that the call is routed to the proper response agency. Many of the MSS systems currently operating or planned for operation in the near future are capable of providing position accuracy within 125 meters as required in Phase II of the Commission's E911 Order.[21] For example, GPS contained in the MSS handset will provide a horizontal accuracy of 100 meters with selective availability activated.[22]

X. COORDINATION IS REQUIRED IN BANDS SHARED ON A CO-EQUAL BASIS WITH GOVERNMENT SYSTEMS.

NTIA supports the Commission's proposal that any 2 GHz MSS system authorized to operate inter-satellite service links in bands shared on a co-equal basis with Government operations would be required to coordinate with Government systems as a general rule.[23] However, within the 54.25-71 GHz range, the Commission should require that 2 GHz MSS licensees of non-geostationary inter-satellite links be limited to the 65-71 GHz band.[24]

XI. DISTRESS AND SAFETY RULES SHOULD BE ADOPTED FOR 2 GHz MSS SYSTEMS.

NTIA supports the Commission's tentative conclusion that distress and safety rules should be adopted for 2 GHz MSS systems.[25] The 2 GHz MSS operators providing safety and rescue services should coordinate with the Interagency Committee on Search and Rescue

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[21] *Id.*

[22] ICD-GPS-200, NAVSTAR GPS Space Segment/Navigation User Interfaces (Public Release Version), ARINC Research Corporation (July 3, 1991).

[23] *See 2 GHz MSS NPRM* at ¶ 70.

[24] Letter from William T. Hatch, Acting Associate Administrator, Office of Spectrum Management, to Richard Smith, Chief, Office of Engineering and Technology, Federal Communications Commission (May 18, 1998).

[25] *Id.* at ¶ 93.

(ICSAR) and all other similar domestic and international search and rescue organizations. NTIA recommends that the Commission modify Section 25.143 (f) of its Rules to include the 1990-2025/2165-2200 MHz bands.

XII. THERE IS CURRENTLY NO NEED FOR REGULATORY PROVISIONS FOR AERONAUTICAL MOBILE SATELLITE (ROUTE) SERVICE IN THE 2 GHz MSS BANDS.

The Commission asks for comments specifically from the aviation community about the need and conditions for Aeronautical Mobile Satellite (Route) Service (AMS(R)S) offerings in the bands allocated for 2 GHz MSS.[26] There are no identified traffic requirements for AMS(R)S in the 2 GHz bands at this time and therefore we see no need for regulatory provisions for AMS(R)S at 2 GHz. However, ICAO Standards and Recommended Practices (SARPS) have been developed for the 1.5/1.6 GHz geostationary MSS[27] and currently are under development for 1.6 GHz non-geostationary systems. Priority must be given to AMS(R)S traffic within MSS systems in specific bands. At this time, action needed is to strengthen the existing ITU Radio Regulation footnotes addressing AMS(R)S priority and preemption by including a requirement for AMS(R)S provision, and to complete the ITU-R Working Document toward a Draft New Recommendation on MSS provision of AMS(R)S.

XIII. FURTHER DISCUSSION IS NEEDED ON THE USE OF RADIONAVIGATION SATELLITE SERVICE FREQUENCIES.

The Boeing Company proposes to operate its planned Navigation Augmentation Service payload in the 1565.42-1585.42 MHz band which is part of the 1559-1610 MHz RNSS band

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[26] *Id.* at ¶ 22.

[27] *International Standards and Recommended Practices and Procedures for Air Navigation Services, Aeronautical Communications Amendment 70* (March 20, 1995).

used by GPS.[28] Detailed discussion of the technical parameters of the proposed system will be necessary with the Department of Defense and the FAA before NTIA could concur on the Boeing proposal. These discussions are necessary to ensure that interference is not caused to GPS.

XIV. RADIO ASTRONOMY OPERATIONS IN THE 10.68-10.7 GHz BAND MUST BE PROTECTED FROM THE OUT-OF-BAND EMISSIONS OF 2 GHz MSS FEEDER DOWNLINKS IN THE 10.7-11.7 GHz BAND.

One of the 2 GHz MSS participants has identified the 10.7-10.95 GHz and 11.2-11.45 GHz bands for their feeder downlinks.[29] Radio astronomy operations have a primary allocation in the 10.68-10.7 GHz band. Footnote U.S.211 urges space stations in the 10.7-11.7 GHz band to take all practical steps to protect radio astronomy operations.[30] Even unwanted emissions through the sidelobes of the antenna may completely destroy observations. The harmful interference limit in the 10.68-10.7 GHz band from terrestrial transmitters to a radio astronomy receiver is -240 dBW/m^2/Hz.[31] The terrestrial transmitters are assumed to enter through the zero dB sidelobe of the antenna which is approximately 19 degrees off-axis of the mainbeam of the radio astronomy antenna. For satellite downlink transmissions, which will be within 5 degrees of the mainbeam axis of the radio astronomy antenna, an extra 15 dB of attenuation is required. Satellite transmitters would then have to meet a level of at least -255 dBW/m^2/Hz in the 10.68-10.7 GHz band. Therefore, to protect radio astronomy receivers, the aggregate power flux

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[28] *See 2 GHz MSS NPRM* at ¶ 68.

[29] *See 2 GHz MSS NPRM* at ¶ 50.

[30] *See* 47 C.F.R. § 2.106.

[31] Recommendation ITU-R RA.769-1, Protection Criteria used for Radioastronomical Measurements; Recommendation ITU-R RA.1237, Protection of the Radio Astronomy Service from Unwanted Emissions Resulting from Applications of Wideband Digital Modulation,

density from all satellites in a constellation employing the 10.7-10.95 GHz and 11.2-11.45 GHz band for feeder downlinks would have to be at least -255 dBW/m^2/Hz.

XV. COORDINATION IS REQUIRED FOR 2 GHz MSS FEEDER LINKS OPERATING IN THE BAND 17.8-20.2 GHz.

Three of the 2 GHz MSS participants have identified spectrum in the 17.7-20.2 GHz band for their feeder uplink and downlink bands.[32] Footnote U.S.334 authorizes the use of the 17.8-20.2 GHz band for Government space stations and associated earth stations in the fixed-satellite service on a primary basis. NTIA requests that the 2 GHz MSS feeder link operations in the 17.8-20.2 GHz band be subject to the standard process in which the Commission coordinates such applications through the Frequency Assignment Subcommittee (FAS) of the Interdepartment Radio Advisory Committee (IRAC) to ensure that harmful interference between MSS feeder links and Government operations is minimized.

XVI. POTENTIAL OUT-OF-BAND INTERFERENCE TO GOVERNMENT SPACE OPERATIONS IN THE 2200-2290 MHz BAND MUST BE TAKEN INTO CONSIDERATION.

The Commission seeks comment on potential adjacent band interference between 2 GHz MSS downlinks in the 2165-2200 MHz band and Government space research, Earth exploration-satellite, and space operation space system downlinks in the 2200-2290 MHz band.[33] Government systems operating in the 2200-2290 MHz band use omni-directional satellite antennas that produce a low signal level at the surface of the Earth, thus requiring that high gain antennas be employed by the receiving earth stations. These high gain antennas will be more

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[32] *See 2 GHz MSS NPRM* at ¶ 50.

[33] *See 2 GHz MSS NPRM* at ¶ 115.

susceptible to interference from the out-of-band emissions of 2 GHz MSS downlinks in the upper portion of the 2165-2200 MHz band.

The Commission has made no proposal regarding the power levels for the 2 GHz MSS systems. The allowable power level adopted will have a direct impact on the out-of-band emissions produced above 2200 MHz. It is envisioned that in order to make maximum use of the spectrum, 2 GHz MSS operations will be permitted to operate up to the edge of the band. If current emission limits are employed,[34] the out-of-band emissions of the 2 GHz MSS downlinks will only be attenuated by 25 dB in the lower portion of the 2200-2290 MHz band. Depending on the power levels adopted for the 2 GHz MSS downlinks this out-of-band interference could be significant.

NTIA is concerned that the out-of-band emissions from the 2 GHz MSS downlinks operating in the upper portion of the 2165-2200 MHz could interfere with adjacent band Government space operations. Moreover, interference to adjacent band Government space systems must be taken into consideration when the Commission adopts power limits and out-of-band emission limits for the 2 GHz MSS downlink band.

XVII. AERONAUTICAL RADIONAVIGATION OPERATIONS IN THE 13.25-13.4 GHz BAND SHOULD BE TAKEN INTO CONSIDERATION WHEN THE POWER LIMITS AND OUT-OF-BAND EMISSION LIMITS FOR THE 12.75-13.25 GHz FEEDER UPLINK IS ESTABLISHED.

One of the 2 GHz MSS participants has identified the 12.75-13.25 GHz band for their feeder uplink.[35] The adjacent 13.25-13.4 GHz band is allocated to the aeronautical

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[34] *See* 47 C.F.R. § 25.202(f).

[35] *See 2 GHz MSS NPRM* at ¶ 50.

radionavigation service on a primary basis. The band is used mainly for airborne doppler navigation radars that operate throughout the band. The Commission has made no proposal regarding the power levels for the 2 GHz MSS feeder uplinks. The allowable power level adopted will have a direct impact on the out-of-band emissions produced above 13.25 GHz. It is envisioned that in order to make maximum use of the spectrum, feeder uplink operations will be permitted to operate up to the edge of the band. If current emission limits are employed[36] the out-of-band emissions of the feeder uplinks will only be attenuated by 25 dB in the lower portion of the 13.25-13.4 GHz band. Depending on the power levels adopted for the 2 GHz MSS feeder uplinks the out-of-band signal levels could be significant. Therefore, NTIA requests that aeronautical radionavigation receivers operating above 13.25 GHz be taken into consideration when the Commission adopts power and out-of-band emission limits for the 12.75-13.25 GHz feeder uplink band.

XVIII. EARTH EXPLORATION-SATELLITE SERVICE IN THE 10.6-10.7 GHz BAND REQUIRES PROTECTION FROM THE OUT-OF-BAND EMISSIONS OF 2 GHz MSS FEEDER DOWNLINKS IN THE 10.7-10.95 GHz BAND.

One of the 2 GHz MSS participants has identified the 10.7-10.95 GHz band for their feeder downlink.[37] The Earth Exploration-Satellite Service (passive) or EESS (passive) has a primary allocation in the 10.6-10.7 GHz band which is adjacent to the 10.7-10.95 GHz band proposed for 2 GHz MSS feeder downlinks. The passive sensors that utilize this band gather vital environmental and atmospheric data by measuring small changes in the ambient noise temperature of the Earth as observed from orbit by the sensor instruments. To achieve the

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[36] *See* 47 C.F.R. § 25.202(f).

[37] *See 2 GHz MSS NPRM* at ¶ 50.

appropriate 1 Kelvin accuracy on these measurements as given in ITU-R Recommendation SA.1028-1,[38] a permissible interference level of -163 dBW in the 100 MHz measurement bandwidth has been established by ITU-R Recommendation SA.1029-1.[39] This interference level cannot be exceeded for more than 1 percent of the sensor's measurement cells either by in-band or by out-of-band emissions. Any MSS feeder downlinks operating in the 10.7-10.95 GHz band could potentially cause interference to orbiting passive sensors of the EESS (passive) through reflections off of the Earth's surface. Detailed study would be required in order to determine what the permissible power levels and out-of-band emission characteristics of any MSS feeder downlinks would have to be in order to protect the passive sensors operations in the adjacent 10.6-10.7 GHz band.

XIX. INTERFERENCE TO GOVERNMENT SPACE OPERATIONS IN THE 2025-2110 MHz BAND FROM 2 GHz MSS UPLINKS CAN BE MINIMIZED IF CARE IS TAKEN DURING THE INITIAL DESIGN PHASE OF THE MSS SYSTEM

The band 1990-2025 MHz is being proposed by the Commission for the 2 GHz MSS uplink.[40] This band is adjacent to the 2025-2110 MHz band that is allocated to Government space research, Earth-exploration satellite, and space operation system earth stations. The band 2025-2110 MHz is extensively used by the National Aeronautics and Space Administration (NASA) and the National Oceanic and Atmospheric Administration (NOAA). NASA recommends that ITU-R Recommendations could be used in the development of policies and rules for the

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[38] Recommendation ITU-R SA.1028-1, Performance Criteria for Satellite Passive Remote Sensing.

[39] Recommendation ITU-R SA.1029-1, Interference Criteria for Satellite Passive Remote Sensing.

[40] *See 2 GHz MSS NPRM* at 4.

implementation of MSS at 2 GHz. NASA believes that if care is taken in the initial design phases of MSS systems that mutually satisfactory, interference-free operations of both services is feasible.[41]

XX. CONCLUSION

NTIA urges the Commission to consider carefully the issues raised in these comments in an effort to develop a workable arrangement that would provide spectrum to meet the projected demand of MSS and facilitate the global roaming of MSS terminals while protecting GNSS, aeronautical radionavigation, and radio astronomy operations.

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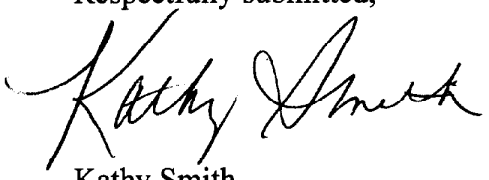
[41] Letter from David Struba, NASA IRAC Representative and Richard Barth, DOC IRAC Representative, to William T. Hatch, Chairman of the Interdepartment Radio Advisory Committee, Department of Commerce (June 21, 1999).

For the foregoing reasons, NTIA submits these comments.

Respectfully submitted,



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